SUMMARY OF DATA MANAGEMENT SYSTEM

Developing an integrated data management system for the transfer, storage, and manipulation of data is an integral part of a FFMS at a HTRW site. The data management system encompasses the techniques used to gather and manage the data of a real-time, fixed fenceline monitoring system.

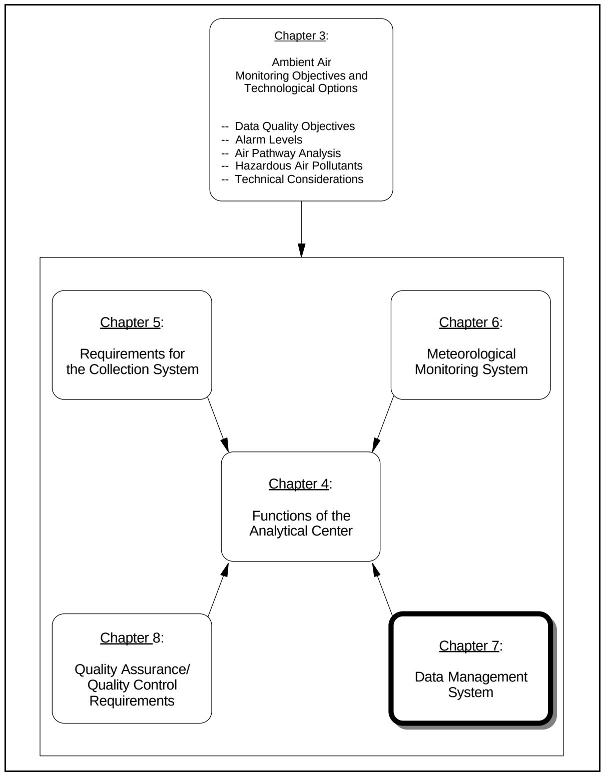
SECTION I: INTRODUCTION

SECTION II: DATA ACQUISITION SYSTEM DESIGN, OPERATION, AND USERS

- Introduction
- Data Acquisition System
- Network Configuration
- Data Receptors and Users
- Component Testing and Calibration

SECTION III: DATA COMPILATION, STORAGE, TRANSMISSION, AND REPORTING

- Data Files
- Data Reporting Forms and Electronic Files
- Daily and Monthly Reports
- Data Validation Procedures
- Meeting the Project DQOs



The main function of the Data Management System is to collect air quality data from remote sites, transmit it to a central point, process and store the data, then report the data to be used in site assessment reporting. Chapter 7 discusses data acquisition; data compilation, storage and reporting; and data validation.

Data management procedures for HTRW site perimeter ambient monitoring programs are characterized by the need to store and integrate large volumes of data derived from a variety of data sources. Because these data may be collected over a long period of time, developing an integrated DAS for the transfer, storage, and manipulation of data to create reports is an essential element of any monitoring program.

The integration and management of the perimeter air monitoring program data should be supported by a central, integrated data base system located in the Analytical Center. The design and structure of the selected software must be compatible with program objectives and, at a minimum, provide:

Panel 7-1. Overview of Data Management System.

- Storage of all acquired data.
- Ability to enter and access field and laboratory information.
- Retrieval of data and preparation of standardized reports.

Panel 7-1. Overview of Data Management System.

7-1. Introduction

The purpose of this chapter is to provide information on the techniques that will be used to gather and manage the data of a real-time FFMS. The types of data that will be processed are the chemical parameter and speciated compounds detailed in Chapters 4 and 5 of this manual and meteorological data as described in Chapter 6. Data acquisition, compilation, storage, reporting, and validation are discussed in this chapter.

7-2. Data Acquisition System Design, Operation, and Users

a. Introduction. The DAS is one of the most important components of the fixed-fenceline perimeter air monitoring program. In contrast to typical non-hazardous waste site applications where data turnaround times may be several weeks, data turnaround during remediation at HTRW sites typically must be within 1 or 2 days to compare long-term action levels and within hours to compare short-term action levels. Data turnaround times are most stringent when the monitoring data are being compared with short-term action levels during remediation at an HTRW site. In these cases, immediate or real-time feedback of perimeter ambient concentration levels is usually required. The main function of the DAS is to collect air quality data from FFMS sites, transmit it to a central point (usually in the Analytical Center), process and store the data, then report the data that is to be used in HTRW site assessment reporting involving the DCQCR.

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The integration and management of the perimeter air monitoring program data should be supported by a central, integrated data base system located in the Analytical Center. The design and structure of the selected software must be compatible with program objectives and, at a minimum, provide:

- Storage of all acquired data.
- Ability to enter and access field and laboratory information.
- Retrieval of data and preparation of standardized reports.

b. Data acquisition system. The DAS comprises a critical component of the perimeter FFMS. Data acquisition can be done with a device as simple as a strip-chart recorder that produces a physical printout of data collected from monitoring instruments. More typical data acquisition units receive analog or digital signals from monitoring instruments and average these numbers over 1 or more intervals as the data is stored electronically. Commercially available DASs used in HTRW perimeter monitoring systems can both store these numbers and also perform real-time calculations on the data. The ability to perform real-time calculations on the data is essential for any HTRW perimeter monitoring program used for determining upwind/downwind and net concentrations.

The configuration of most data acquisition units (see Figure 7-1) has both analog and digital inputs. Analog inputs come from the meteorological station for instruments measuring wind speed, wind direction, temperature, delta T (ΔT), solar radiation, barometric pressure, relative humidity, and precipitation. Digital input from the real-time analytical system in the Analytical Center is received via an RS-232 port and passed into several data channels representing measured pollutants at each monitoring station. The DAS determines which station is upwind by monitoring the wind direction and then, using monitoring results, calculates a net concentration between the upwind and downwind stations. The upwind station is determined by which quadrant the wind direction falls, as described in Chapter 6. As discussed, the HTRW site is assigned quadrants as:

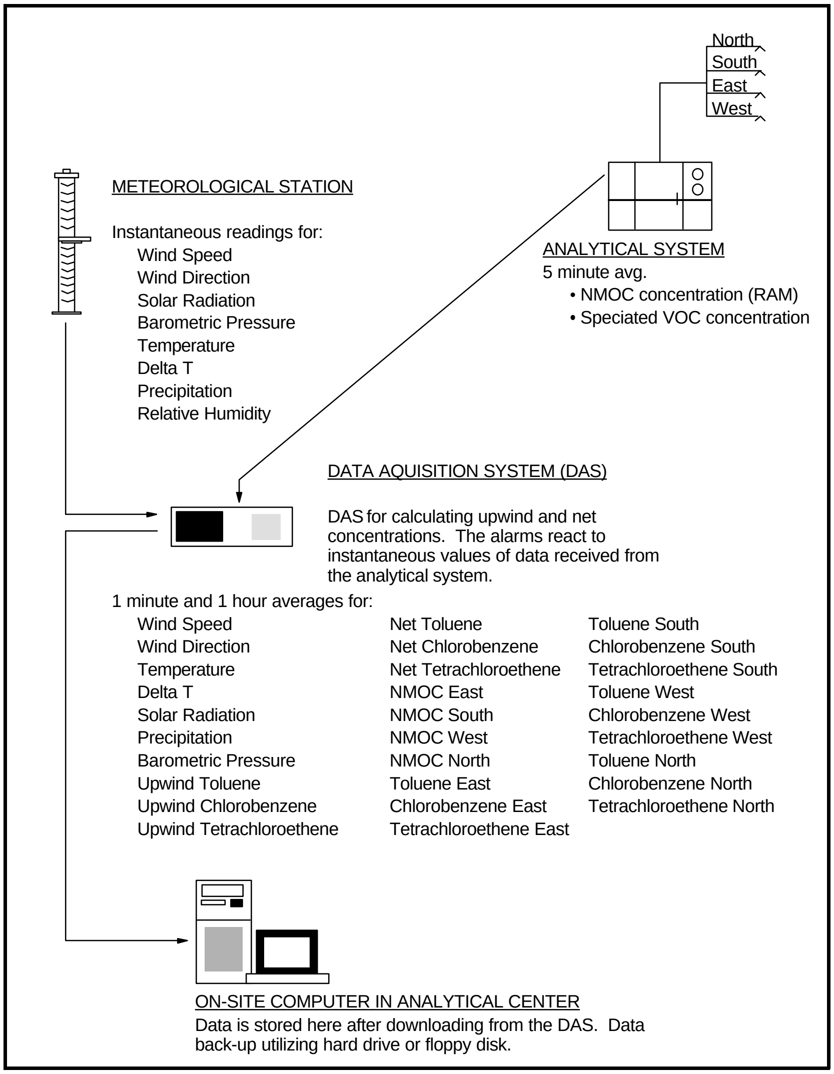

Figure 7-1. Example of data acquisition, storage, and reporting configuration, for a FFMS at a HTRW site.

- Q1: North<45°, >315°and <405°
- Q2: East>45° and < 135°,>405° and <495°
- Q3: South>135° and < 225°, >495°
- Q4: West>225° and <315°

The data logger holds instantaneous values, but only stores averaged values. For instance, the wind direction is updated whenever the meteorological instrument is capable of sending data. The data logger stores each of these values temporarily as it calculates auxiliary (operator determined average between 1 and 15 minutes) and 1-hour averages. These averages are transferred permanently from the DAS to the computer.

c. Network configuration. As shown in Figure 7-2, the DAS is part of a network of instruments. Typical DAS can store only up to a day's worth of data, so the data must be downloaded daily to a computer. This procedure can be done with a direct-cable connection or with a modem. The typical configuration is a direct-cable connection. Additionally, the data from the computer can be transferred via modem and the internet to other off-site offices where the data is stored and backed up with a tape device, as illustrated in Figure 7-2.

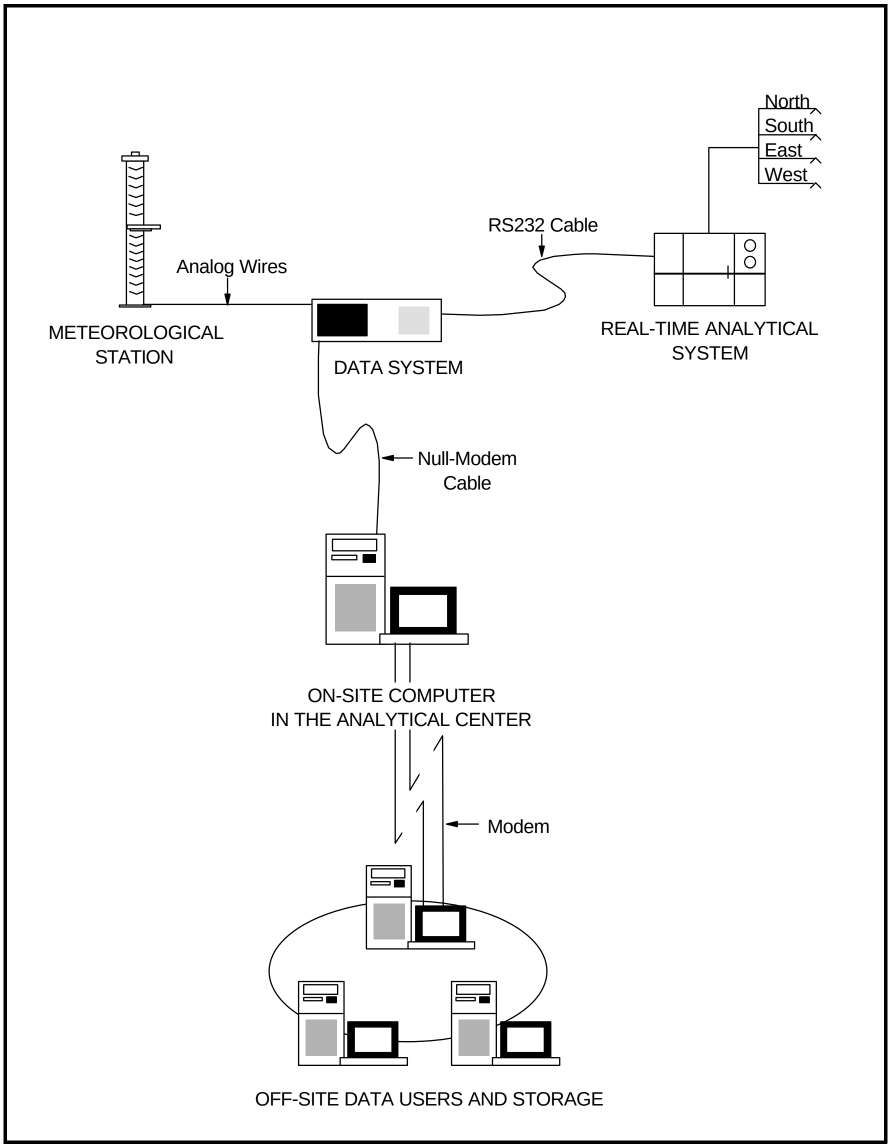

Figure 7-2. Example of HTRW DAS network configuration in the Analytical Center.

d. Data receptors and users. The data from the DAS is used by three categories of receptors. The first category is the Analytical Center. The on-site operators evaluate the real-time data and initiate any required responses for the four alarm-levels, as outlined in Chapter 4 (see Paragraph 4-3). These alarm-levels are based on data from the real-time analytical system and the meteorological station that exceed certain predetermined limits as explained earlier in Chapter 4. The second category is the analysts who perform data analysis and evaluation. The third category of users are the report receipients.

e. Component testing and calibration. The meteorological station components are tested by creating inputs and verifying the values on the data acquisition unit. For instance, the wind speed instrument would be held in place which should produce a specified voltage. In this example, the voltage should equate to zero velocity in the data acquisition unit, as discussed in Chapter 6. For the analytical system, known sample concentrations are measured with the analytical system for validation, and the DAS values are checked for accuracy and acceptable transfer of the data. Lastly, the data transferred to the computer is validated to ensure that the transfer took place.

7-3. Data Compilation, Storage, Transmission, and Reporting

a. Data files. The information from the DAS is downloaded (polled) daily (usually at 2400 hours) to the computer and stored in electronic files in the Analytical Center. All hourly and auxiliary averages and sigmas since the last polling, edit exceptions, changes in input line status, and any calibration data may be retrieved. These files can also be sent and stored in off-site office networks where tape backups are performed, as illustrated in Figure 7-3. The system keeps a "raw" database and a "validated" database for hourly values to ensure data integrity. Hourly data retrieved via polling is put into both databases. The Analytical Center may later edit only the validated database; the raw data can never be changed.

The data files can be stored in a binary format but can be converted to standard format with most commercially available software. As shown in Figure 7-4, this format allows the data to be analyzed in any appropriate software package.

b. Data reporting forms and electronic files. The DAS provides several reports for displaying both real-time and archived data. Real-time data, such as voltages, readings, and alarms, can be displayed on the data acquisition unit itself. Real-time bar graphs, historical graphs (plotting acquired points) and trending plots (plotting acquired points and adding real-time points) can also be displayed. For reviewing older data, software on the computer can generate several types of reports: status reports, historical reports, graphs, and monthly reports. With the exception of the "monthly report," which can report using either the raw or the validated data, the following reports can be produced from the validated database:

(1) Status reports. Status reports for calibration (if auto-calibration instruments are used) and data recovery are available. The data recovery report (see Figure 7-5) shows the number and percentages of valid scans from all instruments over an operator defined time period.

(2) Historical reports. These reports provide data for given parameters over specified time intervals. Hourly numbers, daily averages, and monthly averages can be reported. Figure 7-6 illustrates a single parameter 24-hour report.

(3) Graphs. There are several graphs available for displaying information listed below:

- Daily Single Parameter Graph--displays hourly averages for a selected day and parameter.

- Multi-Day Single Parameter Graph--displays hourly averages for a specified number of days.

- Monthly Single Parameter Graph--displays hourly averages for a selected month and parameter with zoom features to a focus on a specified number of days.

- Daily Multi-Site Graph--displays hourly averages for a selected day for a specified number of selected sites on one graph.

- Multi-Day Multi-Site Graph--displays one graph hourly averages for a specified number of days for a specified number of selected sites.

- Daily Multi-Parameter Graph--displays hourly averages for a selected day for a specified number of selected parameters on one graph.

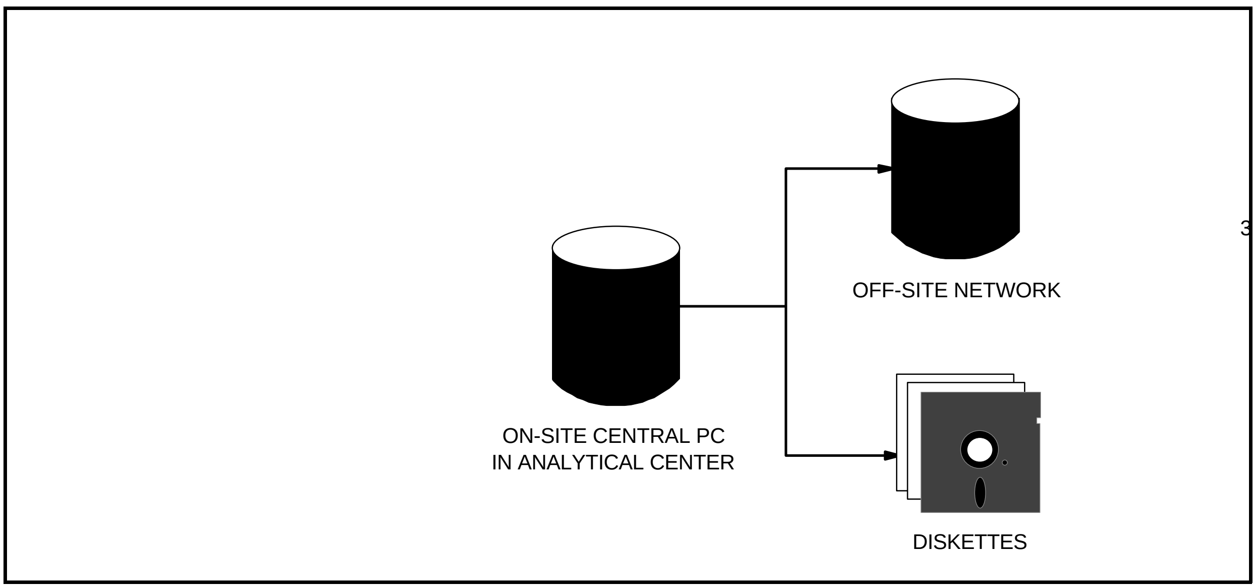

Figure 7-3. Example of data file transmission and storage as part of a HTRW DAS.

- Multi-Day Multi-Parameter Graph--displays hourly averages for a specified number of selected parameters for a specified number of days on one graph.

- Calibration Graph for 1 Month--displays calibration values for one parameter for 1 month.

(4) Frequency distribution. Frequency Distribution Reports are a report of a selected pollutant from the hourly data files. An averaging interval may be specified by the operator. A Joint Frequency Distribution Report shows two or more selected pollutants and a wind or pollution rose on the screen.

c. Daily and monthly reports. A meteorological report (see Chapter 6) summarizing meteorological information for the site is generated daily. This data may be required as part of the DCQCR.

The USACE may require a separate DCQCR for projects involving a large amount of onsite chemical parameter measurement activities. Minimum amounts of such measurement activity can be included in the contractor's daily CQC Report.

The FFMS information for the DCQCR shall be provided by the on-site personnel in the Analytical Center responsible for chemical parameter measurement and chemical sample acquisition, and signed by the contractor QC representative to assure that the chemical data resulting from these activities meets the contract documentation requirements.

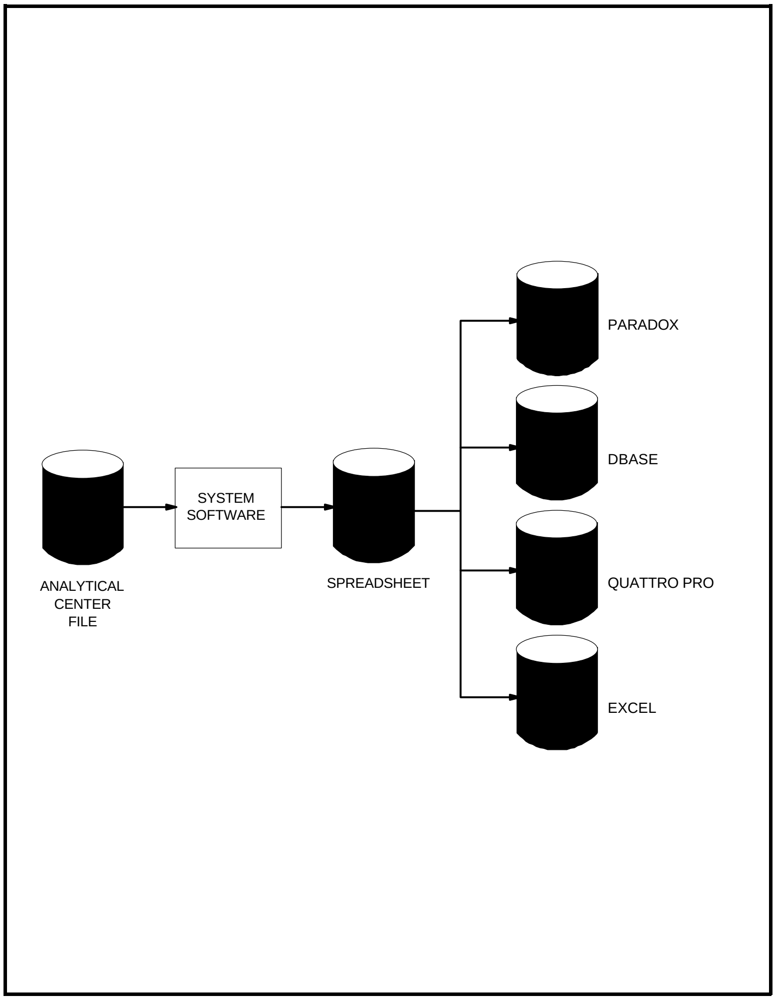

Figure 7-4. Example of data file formats.

The DCQCR should contain, as a minimum, the following:

- Job identification and site numbers.
- Weather including temperature, wind speed and direction, barometric reading, significant wind changes, etc.
- Chemical data acquisition work performed, including specific information identifying project and QA samples collected and calibrations.
- Sampling and sample shipments including shipment and delivery problems that affect project DQO requirements.
- Chemical parameter measurement problems that may affect project DQO requirements, including instrument malfunction, performance requirement failure, etc.

- Any sampling performed as contingency sampling.

- Corrective actions and/or deviations from the approved SAP, including approvals.

- Chemical quality control activities, as part of the three-phase control procedures that were implemented, and confirmation that deviations or actions jeopardizing project DQOs have been documented and

PERCENT RECOVERY REPORT

DAY: 06/25/95
SITE: USACE HTRW - ANYTOWN, USA
TOTAL NUMBER OF SCANS PER PARAMETER: 24

DCN ID	SITE NAME	PARAMETER NAME	NUMBER OF VALID AVG SCANS	NUMBER OF TOTAL OF CALIBRATION VALID SCANS	SCANS	PERCENT RECOVERY
01		WNDSP	24	0	24	100.0
		WNDDR	24	0	24	100.0
		TEMP	24	0	24	100.0
		DELTA	24	0	24	100.0
		SOLAR	24	0	24	100.0
		PRECI	24	0	24	100.0
		BARPR	24	0	24	100.0
		SIGMA	24	0	24	100.0
		UPTOU	24	0	24	100.0
		UPCLB	24	0	24	100.0
		UPTCL	24	0	24	100.0
		NETOU	24	0	24	100.0
		NECLB	24	0	24	100.0
		NETCL	24	0	24	100.0
		NMAST	24	0	24	100.0
		TOULN	24	0	24	100.0
		TOULS	24	0	24	100.0
		TOULE	24	0	24	100.0
		TOULW	24	0	24	100.0
		CLBZN	24	0	24	100.0
		CLBZS	24	0	24	100.0
		CLBZE	24	0	24	100.0
		CLBZW	24	0	24	100.0
		TCLEN	24	0	24	100.0
		TCLES	24	0	24	100.0
		TCLEE	24	0	24	100.0
		TCLEW	24	0	24	100.0
TOTAL FOR DCN 01			648	0	648	100.0

Figure 7-5. Example of data recovery report from DAS in Analytical Center.

forwarded to project management. A summary of the feedback procedure for any corrective actions taken.

- Signatures of responsible authority and initials of all persons conducting changes/corrective actions.

The DAS can be programmed to provide all minimum contact requirements for the DCQCR.

Monthly, a project summary report can be produced from the DAS with daily meteorological reports and daily wind-roses (joint frequency distribution graphs of wind speed and wind direction). These wind-roses, (See example in Fig. 6-3), are generated on-site and captured into a graphics file that can be sent electronically to any off-site office.

d. Data validation procedures. Data validation is the systematic review of measurement data for outlier and error detection. For FFMS data collected at a HTRW site, there can be three levels of validation: (1) preliminary consistency check and outlier identification, (2) review of data collection processes, and (3) statistical analysis of data to determine consistency between data sets and monitoring devices and to formally identify outliers. Data found to be questionable at any of these levels should be investigated, and an explanation should be sought for the unusual readings. Data validation requirements are project specific and may involve different validation levels for various analytical procedures, as outlined in Figure 7-7.

- **Level 1**. Qualified chemists or air specialists, as part of the Analytical Center, should perform a preliminary visual check for noticeably improbable quantities, peaks or spikes in the data, obvious trends in the data that might result from monitoring equipment malfunction, and other data irregularities. The personnel should also compare data points that share deterministic relationships (e.g., high wind speed readings, wind direction, ambient temperature and wind speed, component quantitiy, and speciated organic concentrations) to identify irregularities. These reviews are performed shortly after the raw data is collected so that investigations can determine the validity of the readings.

- **Level 2**. Qualified personnel should review chain-of-custody, maintenance, calibration, and analysis records to detect any problems with laboratory or field processes or equipment parameters that might lead to nonstandard sampling intervals, insufficient sample volume, or other problems that may negate the sampling event or create questionable results.

- **Level 3**. Qualified statisticians should analyze data for subtle yet unacceptable abnormalities. They should assess the consistency of data collected over time and by different monitoring devices at the same site. They also should use statistical methods to identify outliers in the data that require investigation.

The data validation procedures just outlined are applicable for both real-time and time-integrated monitoring as part of a HTRW monitoring program, as indicated in Table 7-1. The levels of validation involve a QC review by each data collector or generator and an independent review of the entire data set by the Project Quality Assurance Officer. Activities for the integrated program (real-time and time-integrated) are identified in Figure 7-7 and include visual checks for improbable data, peaks or spikes, obvious trends, data relationships

02-09-1996
11:30:16
MET - AIR QUALITY DAILY DATA REPORT
Site: USACE HTRW Site
Any Town, USA
Date:6/25/95

Hour	WNDSP (m/sec)
0	1.20
1	0.80
2	1.20
3	1.10
4	1.20
5	0.80
6	1.30
7	2.00
8	2.20
9	1.60
10	1.00
11	1.50
12	1.60
13	2.50
14	2.20
15	2.70
16	2.30
17	1.80
18	1.70
19	1.60
20	1.30
21	1.10
22	1.10
23	1.10

Figure 7-6. Example of single-parameter 24-hour report from DAS in Analytical Center.

with other parameters (VOCs and wind direction), maintenance, calibration, and analysis records.

e. Meeting the project DQOs. The last step in data evaluation is data quality assessment which determines whether the data reported meets the project DQOs. As defined in Chapter 3, DQOs are defined as qualitative and quantitative statements which clarify project objectives, define appropriate types of data to collect, and specify the limits of uncertainty the decision maker is willing to accept in data that support project related decisions. The reviewer evaluates the data and compares their quality to the project DQOs. If it is determined that the data collected does not meet the project DQOs, then a plan for initiating and implementing corrective action should occur to bring the program back to compliance with the DQOs. The plan should specify (1) conditions that will require corrective actions, (2) personnel responsible for initiating, implementing, evaluating and approving the results of corrective actions, and (3) statement of resolution identifying that program DQOs have been met based upon corrective action or establishing new DQOs.

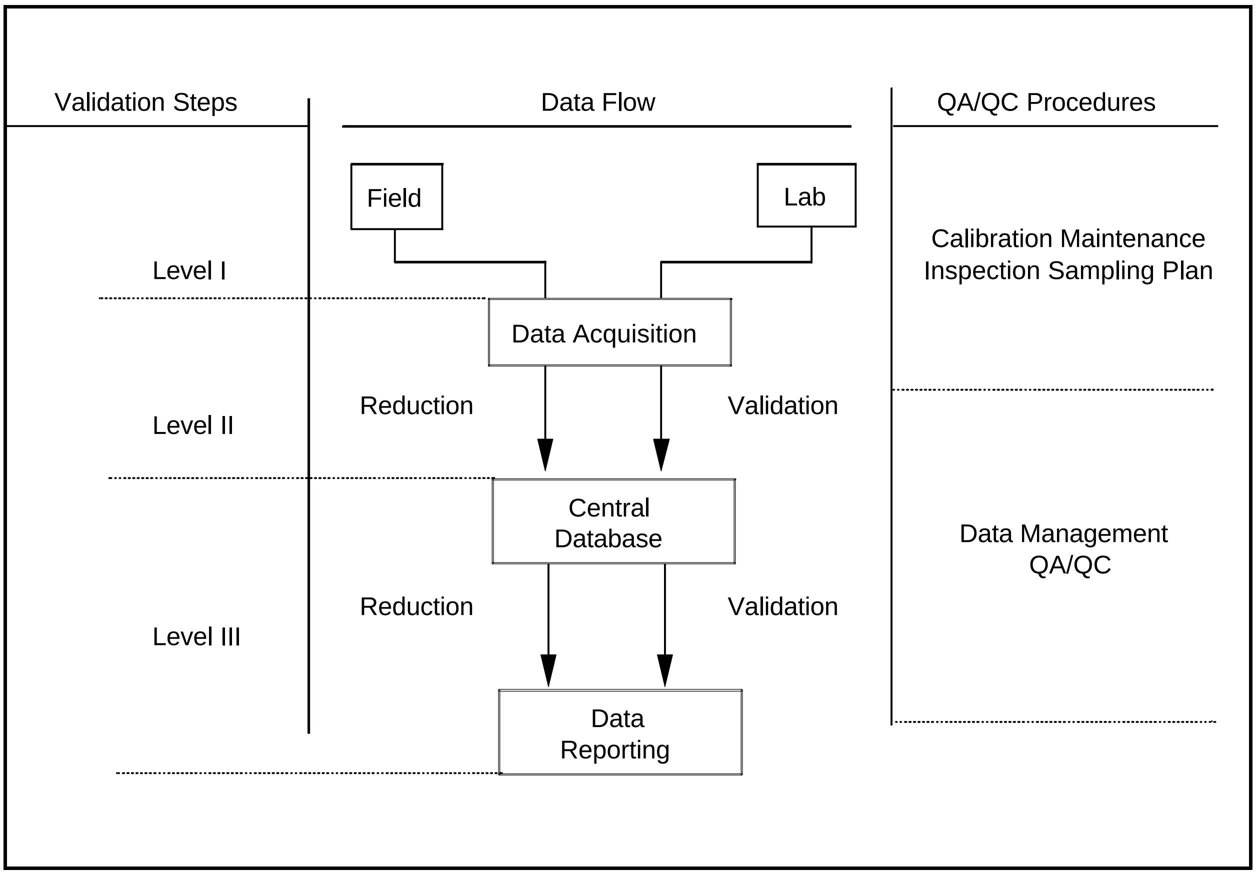

Figure 7-7. Example of levels of data validation recommended by EPA.

Table 7-1
Example of Applicable Levels of Data Validation for Real-Time and Collocated Time-Integrated Methods

Parameter	Example of sampling method	Example of analytical method	Example of level of data validation
Organics Volatile	Real-time sample collected through heat-trace sample lines and analyzed by analytical system	Gas chromatography equipped with photoionization detector for real time analysis	Level 1 and 2
	Time-integrated sample collected in stainless steel SUMMA® canisters utilizing pump system.	Analysis by cryogenic concentration followed by gas chromatography/ mass spectroscopy (GC/MS) analysis.	Level 1, 2, and 3
Semi-volatiles	Time-integrated sample collection on polyurethane foam (PUF/XAD-2) plugs using a high-volume sampling apparatus.	Soxhlet extraction, concentration of the extracts, and analysis using GC/MS detection for PAHs,	Level 1, 2 and 3
Inorganics Total Suspended Particulate (TSP) matter and materials	Time-integrated samples collected on 8 in. X 11 in. quartz fiber filters utilizing high volume sampling technique.	Filter weighted for total mass, then extracted in HCl/HNO_3 by microwave extraction, followed by inductively coupled argon plasma spectroscopy (ICP) analysis for metals.	Level 1, 2, and 3
Meteorological Wind speed, direction, solar radiation, temperature and precipitation	Time-integrated through various instrument specific for meteorological parameters.	No analysis required. Instantaneous value from on-site instruments	Level 1 and 2